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SUDDEN EXTINCTION OF THE LIGHT OF A SOLAR PROTUBERANCE.

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Presented Nov. 14, 1877.

On the 26th of June, 1874, while making my daily observation of the sun with the spectroscope at the Harvard College Observatory, I saw an unusual phenomenon, which may be worth recording. The narrow slit of the instrument was directed on the preceding side, about 270°, just above a group of spots which was then very near the limb, when I saw a brilliant protuberance partly projected on the spectrum, on the side of the rays of less refrangibility. In shape, this hydrogen flame resembled an elongated comma, having its acute extremity directed towards the sun, where it terminated just a little above the chromosphere. The chromosphere under this protuberance formed several slender and acute aigrette-shaped flames, none of which, however, reached it. The large prominence, which was slightly inclined to the limb, had a height of 3′ 37″, and about 3° in its greatest width. Fig. 1.

FIG. 1

When the slit was set wide open, so as to allow the whole protuberance to be seen between its jaws, the comma-shaped flame appeared perfect, and showed plainly its texture. But, when it was observed with a narrower slit, it became partly invisible on the C line; only a short and jagged portion being seen in it on the red side. Fig. 2. When the slit was carried along the protuberance by means of its

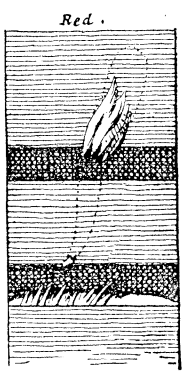

FIG. 2

screw, the portion visible on the C line did not remain constant, but either extended or contracted of a small quantity; the maximum portion visible on the C line never being more than one-fourth the width of the slit, while sometimes it was not seen at all on this line.

The portion of the protuberance projected on the spectrum was considerably more brilliant than the spectrum itself, and about one-third only of its whole length was visible. As the slit was carried along it, the visible parts became invisible near the C line, and invisible parts appeared on the spectrum; and the area of the visible portion either contracted or extended, when seen in different parts.

I had been observing this phenomenon for eight or ten minutes, when, while, looking at it with the slit wide open, the flame suddenly vanished, at $10^h\ 30^m$, no traces of it remaining. As no motion of any kind, no extension, no contraction, could be perceived before or at the moment this phenomenon took place, and as the light did not go out of it gradually, but as suddenly as a flash of lightning, it does not seem that a change of position was the cause of its disappearance, but rather because the light which rendered it visible abandoned it in an instant.

According to theory, this protuberance was moving rapidly away from the earth at the moment of the observation, as it was projected upon the less refrangible side of the spectrum; yet this would fail to explain its sudden disappearance, since for this it should have moved out of sight with an inconceivable velocity.

For over half an hour I watched attentively the same spot in expectation of seeing the flame reappear; employing for this a narrow and a wide slit in succession, but with entirely negative results. I saw no more traces of it, although the small aigrette-shaped flames of the chromosphere, which were still visible, indicated the exact place where it had vanished, and where very probably it still existed, but now as a dark protuberance.

On several occasions I have seen the light abandon a protuberance gradually, but never so suddenly and on such a grand scale; and sometimes I have seen also the light gradually illuminating protuberances which were invisible before, something after the manner of clouds in our atmosphere lighting up and fading into darkness by the appearance or disappearance of the sun. Of course, the illumination of dark solar protuberances cannot be conceived as being due to the reflection of light, as in the case of the clouds in our atmosphere: it is the protuberance itself which is rendered luminous by some change taking place in it. These observations would seem to indicate that on the sun there are sometimes dark and non-luminous protuberances,

which may cause the spots of absorption often observed in the vicinity of spots.

The phenomenon of the gradual illumination of a protuberance was observed in 1869, at Des Moines, Iowa, during the total eclipse of the sun, by Professor William A. Rogers, who accompanied Dr. C. H. F. Peters, on the Litchfield Eclipse Expedition. Professor Rogers was observing a large protuberance on the sun with a 9-inch-aperture refractor, when he saw several protuberances form gradually in the vicinity of the large flame, and at a considerable height above the chromosphere.

The projection of the hydrogen flames on the spectrum is not a very rare phenomenon during the period of maximum of sun spots, and it has been observed several times. However, it may be worth while to record a characteristic case of projection, accompanied with remarkable changes of form, and a visible motion of the protuberance.

On Sept. 10, 1872, at $12^h\ 33^m$, I was observing a small narrow flame forming an arch on the chromosphere, the height of which was equal to $36''$. Fig. 3. Nothing remarkable was to be seen in this protuberance, although it was in the vicinity of a group of spots which was then very near the eastern limb of the sun; but, two minutes later, one of the extremities of the arch reposing on the chromosphere was

FIG. 3

FIG. 4

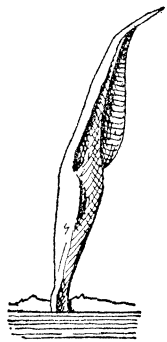

FIG. 5

suddenly detached from the limb, springing up like a distended bow, ascending in an instant to a height of $70''$, then appearing straight and rigid, but twisted like a rope. Fig. 4. For a few seconds, it continued to ascend, at the same time growing wider; and at $12^h\ 37^m$, it had attained its maximum altitude of $118''$. It was then slightly curved. Fig. 5. At $12^h\ 43^m$, the force which had carried it up began to give way, and it then descended rapidly towards the sun, folding

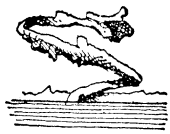
FIG. 6

upon itself in two places, while at the same time it became narrower. Fig. 6. At $12^h\ 45^m$, it had reached its former height; and soon after, it sunk to a level with the chromosphere, and was lost in it.

At the same instant that the arc of hydrogen was distended, it was seen projected on the spectrum opposite the sun, towards the violet. The figure of this protuberance appeared exactly the same, whether it was projected on the spectrum or seen between the wide-open jaws of the slit. However, when the slit was narrow, the flame became invisible on the C line, although it remained projected on the spectrum. When the protuberance, after having reached its greatest altitude, descended rapidly towards the sun, it remained projected on the spectrum just as before, although the descending motion was apparently in a contrary direction to the ascending one; but this did not seem to affect the position of the flame on the spectrum.

CAMBRIDGE, Jan. 12, 1877.